LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

100th PURDUE ROAD SCHOOL

New Bridges Over Lake Barkley and Kentucky Lake

US 68/Ky 80

MARCH 11, 2014

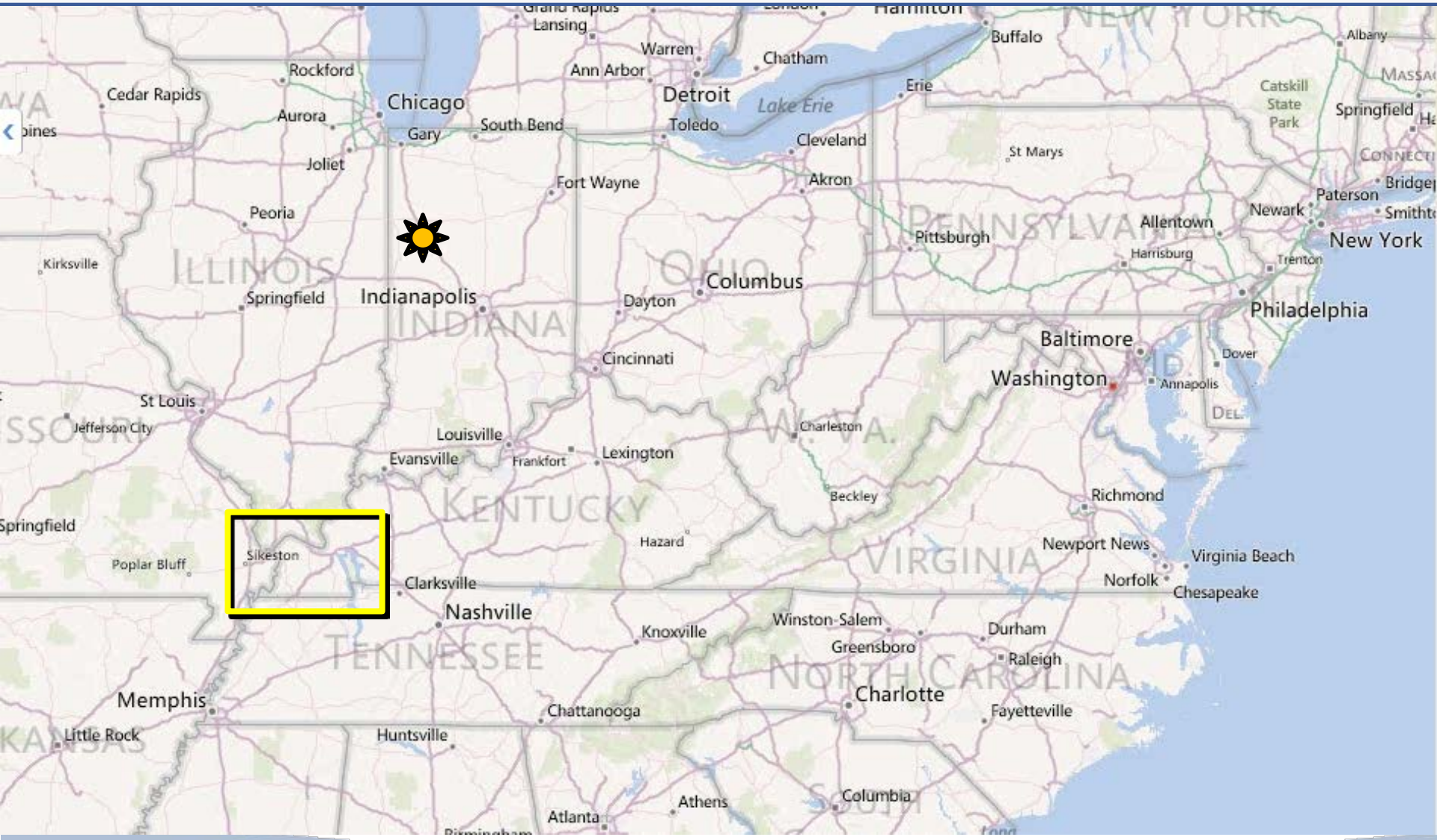
Kentucky UNBRIDLED SPIRIT

Baker

Palmer ENGINEERING

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

LOCATION



LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

LOCATION

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

JACKSON PURCHASE

- Western KY & TN
- Tenn. River to Miss. River
- Ceded to US by Chickasaw Peoples
- Ceded in 1818
- Andrew Jackson & Isaac Shelby
- $300,000

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

KENTUCKY BEND

- 17.5 Sq. Miles
- Surrounded by Miss. River and Tenn.
- Only Access thru Tenn.
- A Church Divided

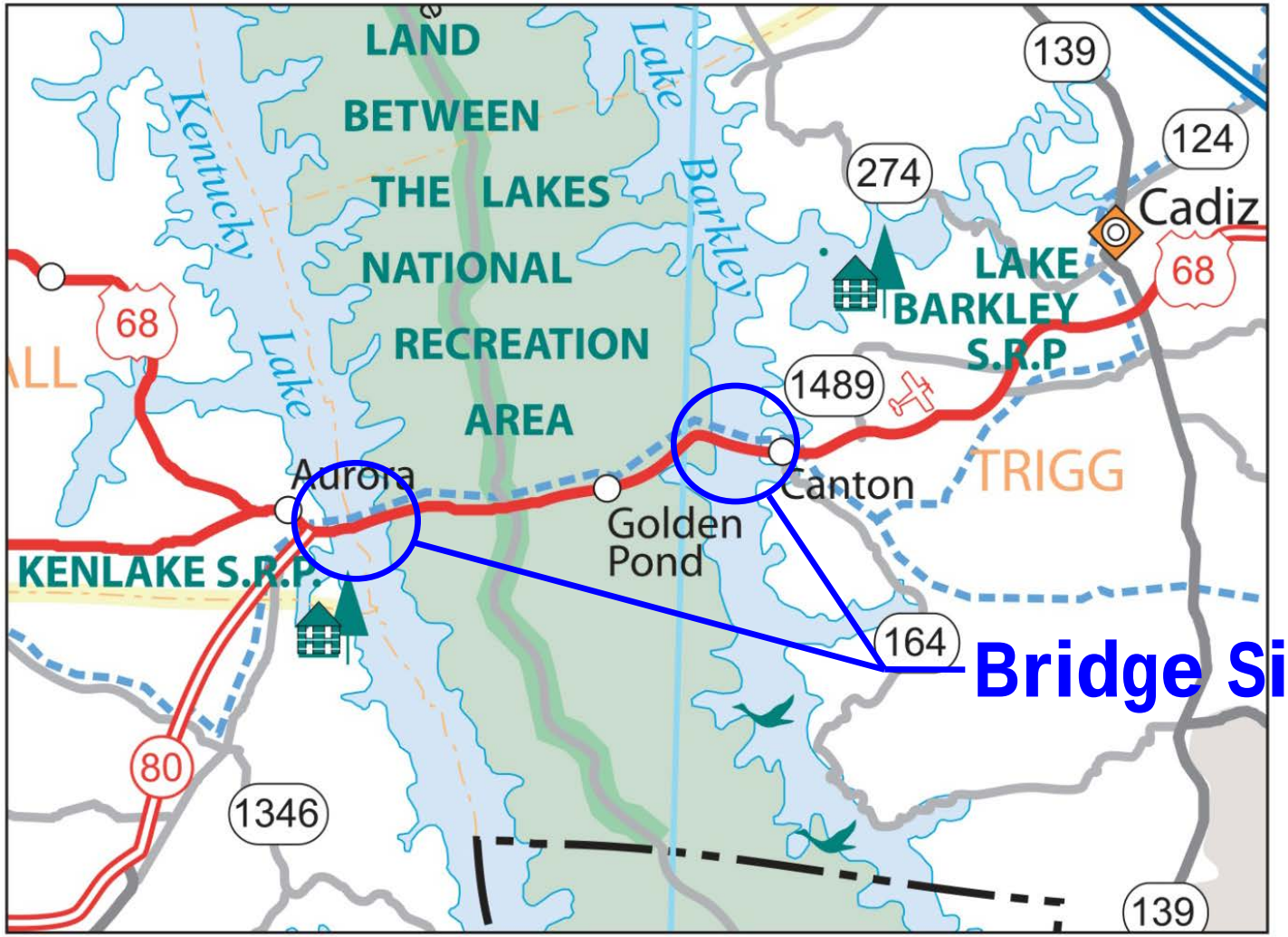
LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

WOLF ISLAND

- 15,000 Acres
- Missouri v. Kentucky, 1870
- No Longer an Island
- Only Access thru Missouri

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

SITE MAP



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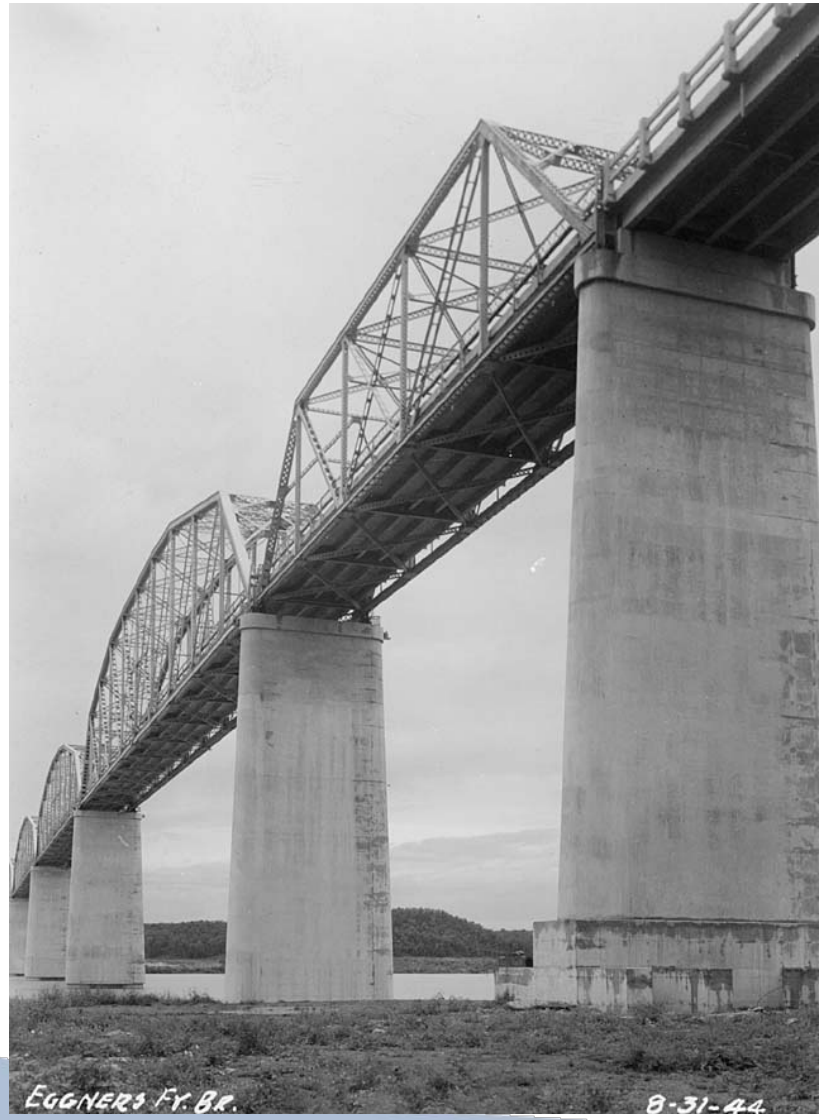
KENTUCKY LAKE

- Tennessee River
- Built by TVA, 1938-1944
- 184 Miles Long
- 2400 Miles of Shoreline
- 160,000+ Acres of Water
- 8,422 Ft Long, 206 Ft High
- 50 Million Tons/Yr of Cargo
- Largest Artificial Lake, E. US

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

KENTUCKY LAKE BRIDGE



Eggner's Ferry Bridge

- Opened March 25, 1932
- Closed July 1943
- Raised 22' – 25'
- Reopened Feb 1944
- 38 Approach Spans
- 5 Thru Truss Spans
- 3348' Total Bridge Length

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

LAKE BARKLEY

- Cumberland River
- Built by USACOE 1959-65
- VP Alben W. Barkley
- 134 Miles Long
- 1000+ Miles of Shoreline
- 57,900 Acres of Water
- 10,180 Ft Long, 157 Ft High
- Eddyville & Kuttawa Reloc'd
- 1.75 Mile Barkley Canal

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

LAKE BARKLEY BRIDGE

Henry R. Lawrence Mem. Bridge

- Opened in 1932
- Closed in 1962
- Raised 10.5 Ft
- Reopened Dec. 1963
- 48 Approach Spans
- 2 Deck Truss Spans
- 2 Thru Truss Spans
- 3045’ Total Bridge Length

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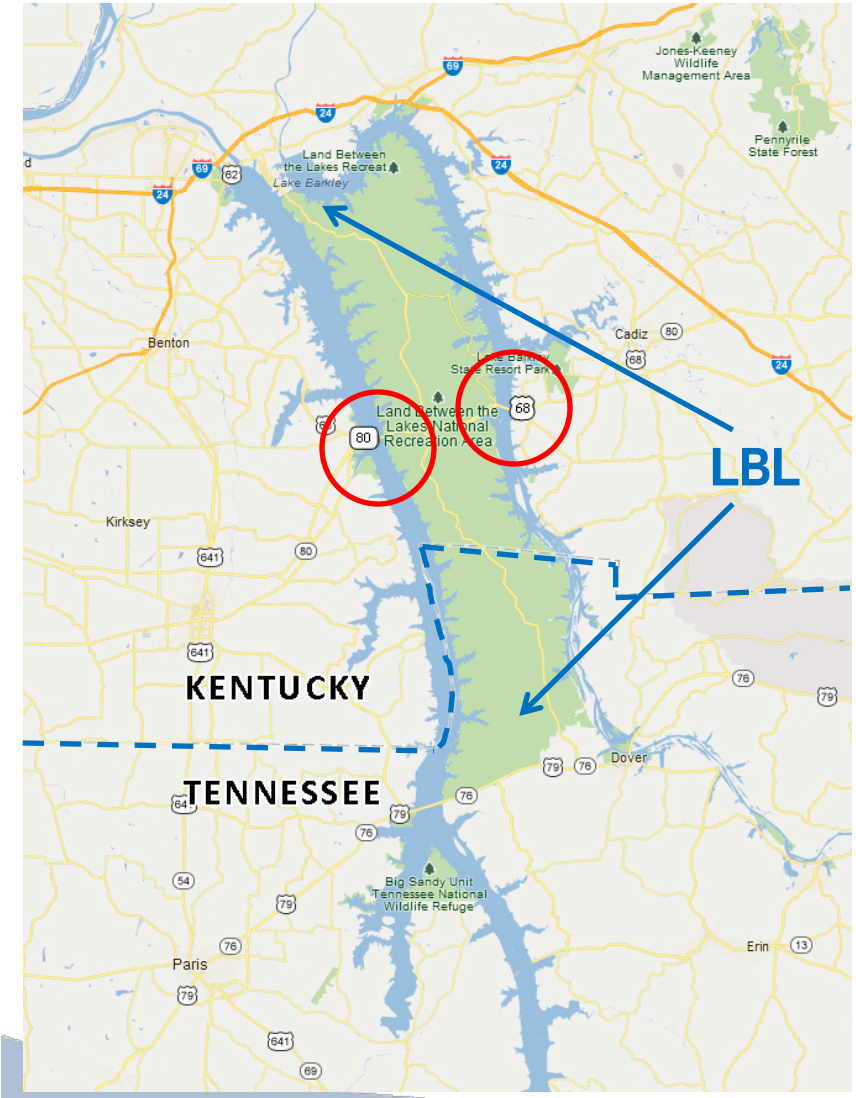
Over Kentucky Lake & Lake Barkley

LAND BETWEEN THE LAKES



- Between Tennessee and Cumberland Rivers
- Lyon & Trigg Counties, KY
- Stewart County, TN
- 800 Families
- Settled in 1780's
- Primary Access: Ferry
- National Recreation Area
- Kennedy Established in 1963
- 170,000 Acres in KY & TN

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

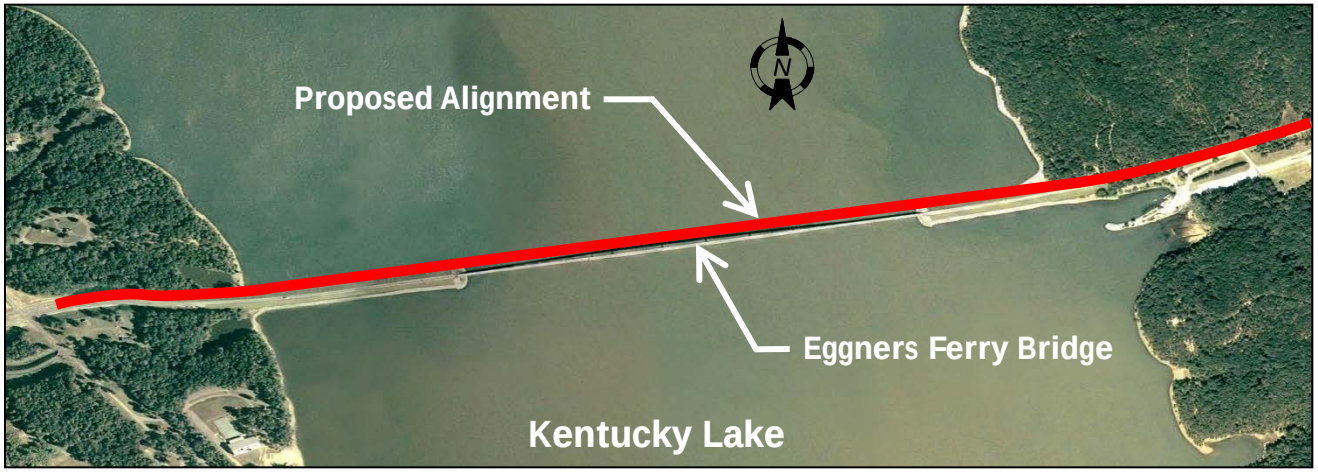
NEW MADRID FAULT

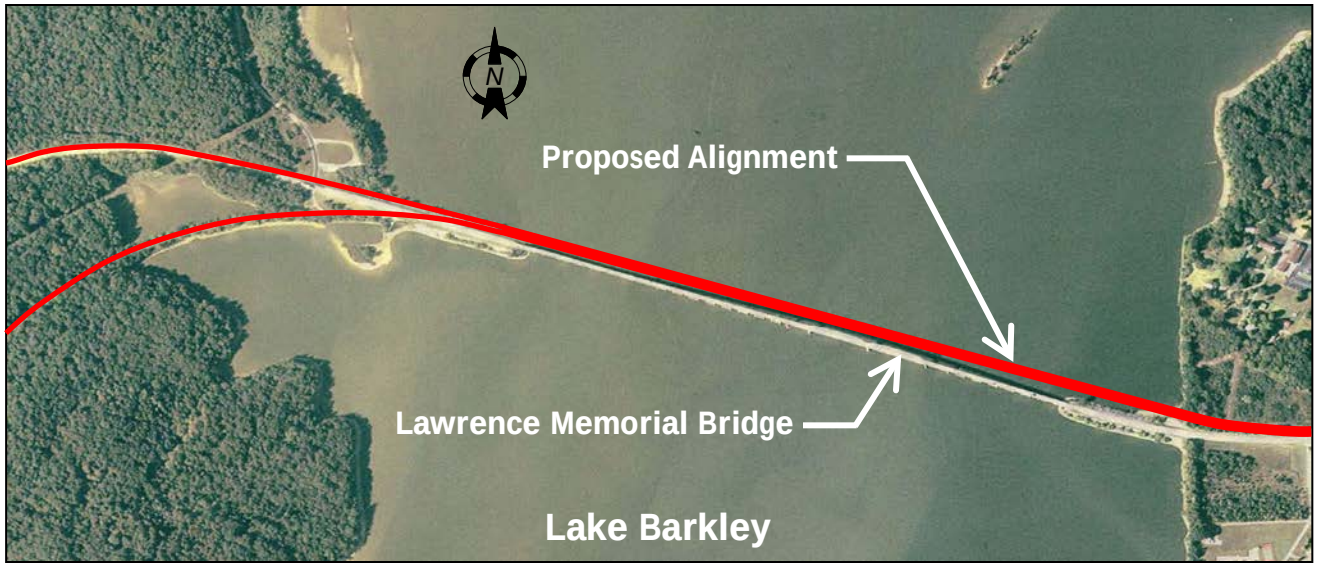
New Madrid Earthquake

- Dec. 16, 1811, M 7.7
- Jan. 23, 1812, M 7.5
- Feb. 7, 1812, M 7.7
- 1800 Aftershocks through Mar. 1812
- Total of 10 of M 6 or Greater
- Largest East of Rocky Mountains
- 3 Meter Uplifts Reported
- 1.5 to 6 Meter Downdrops
- Formed Reelfoot Lake, TN

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

PROJECT ALIGNMENT





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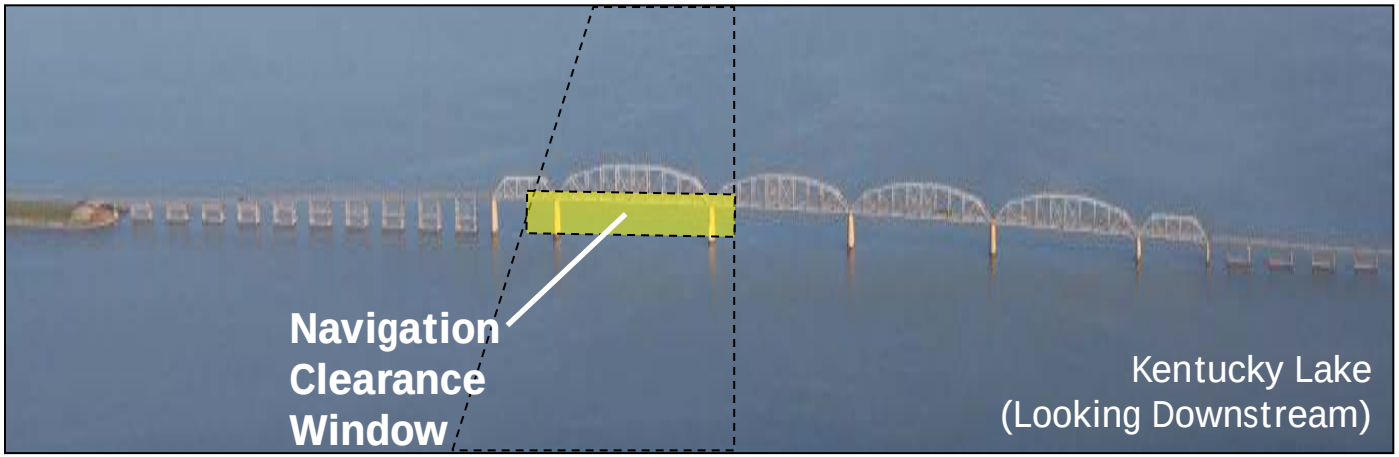
NAVIGATIONAL CLEARANCE

- 502’ Minimum Horizontal Clearance



- 60’ Minimum Vertical Clearance

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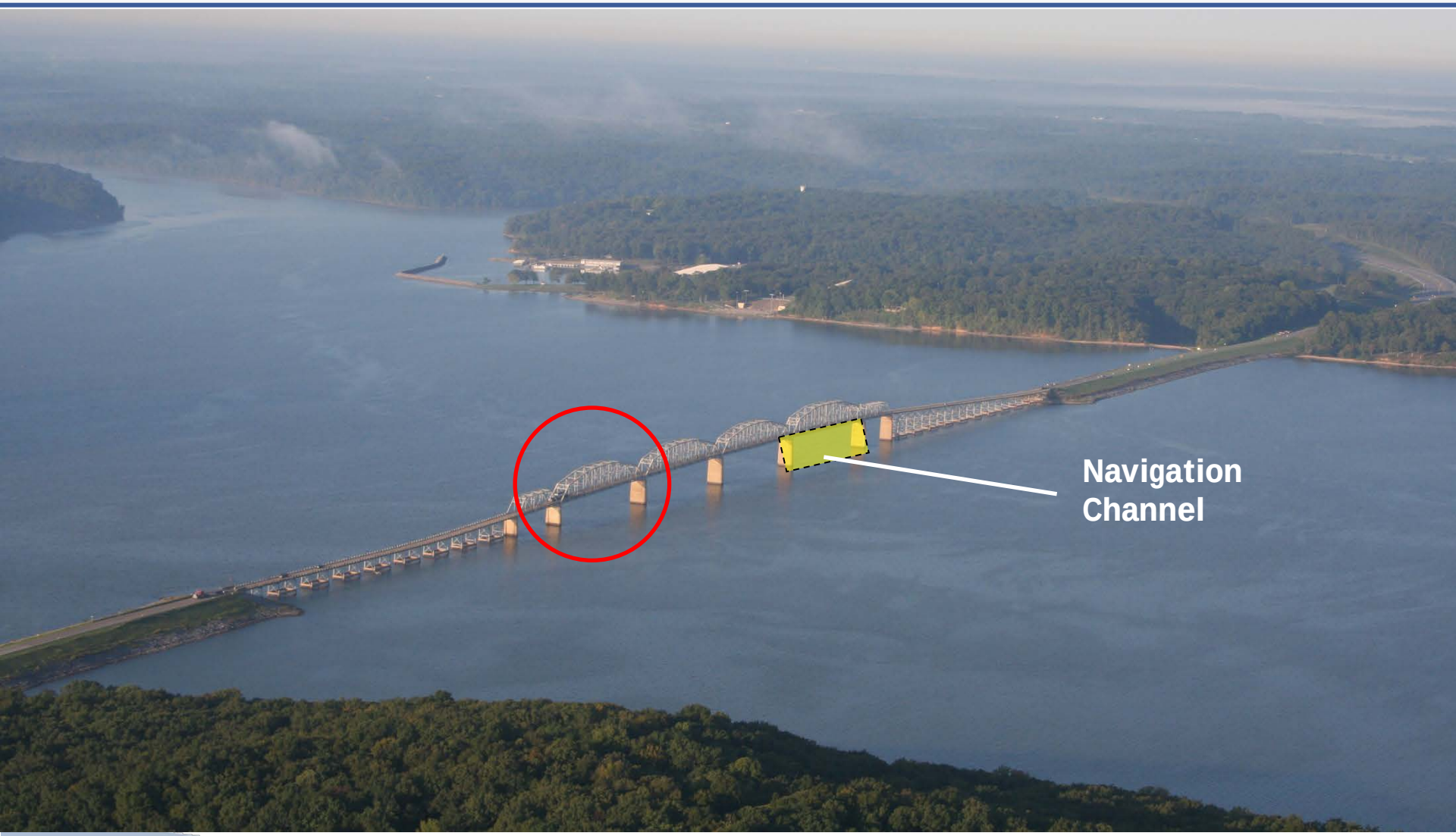
A SMALL CHANGE



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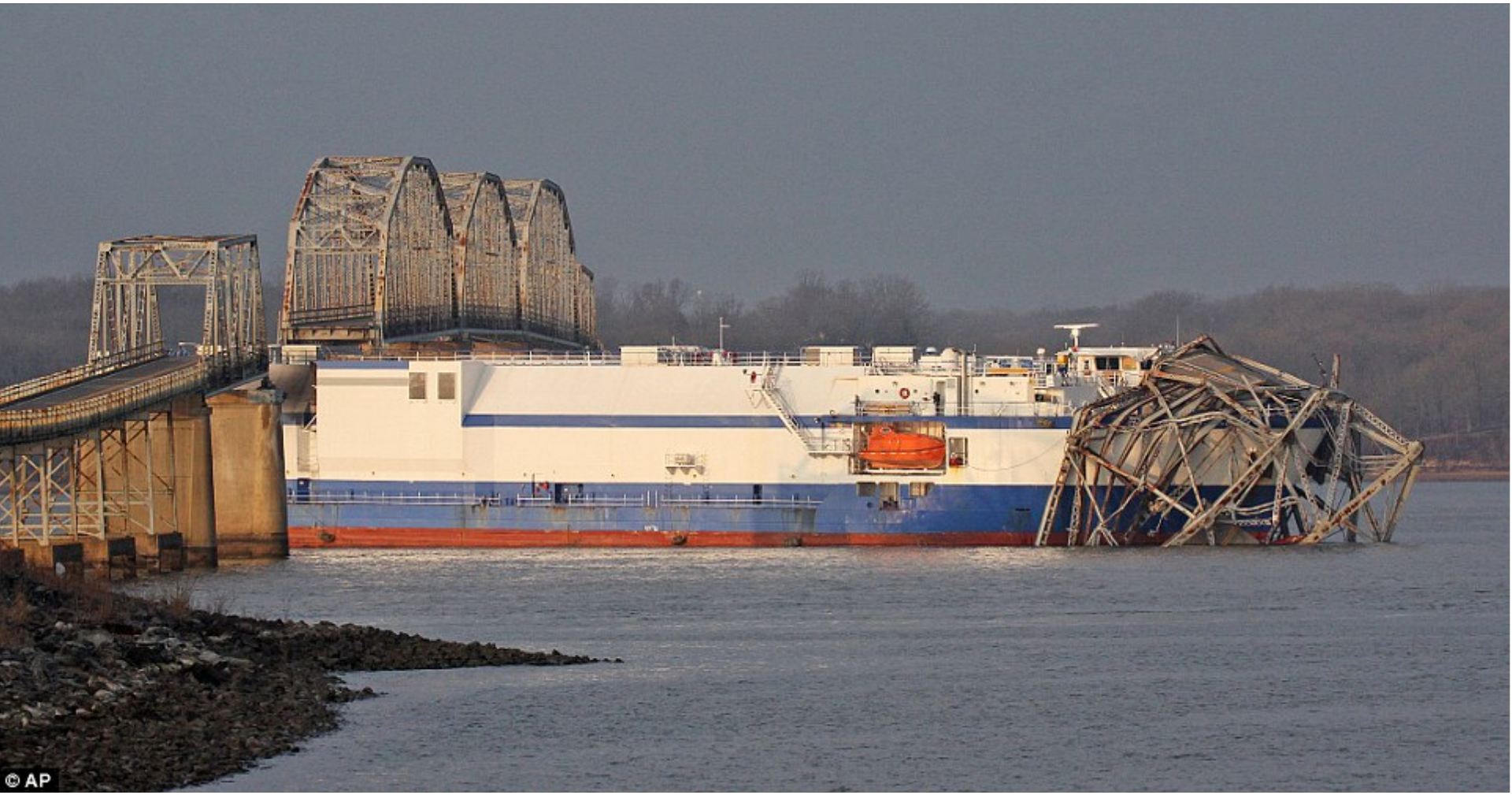
OOOPS !!



LAKE BRIDGES
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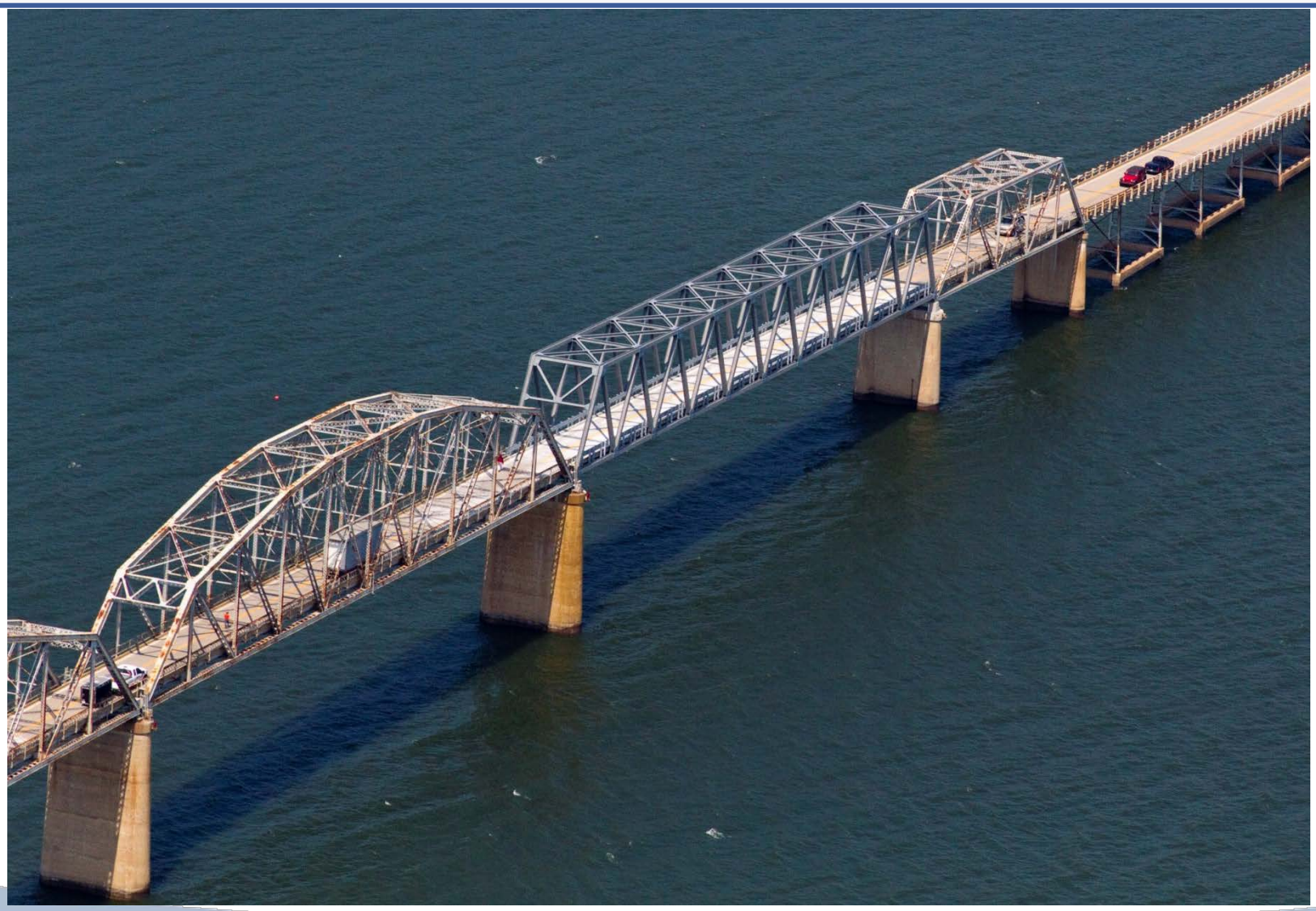
17 WEEKS LATER



BRIDGE TYPE SELECTION

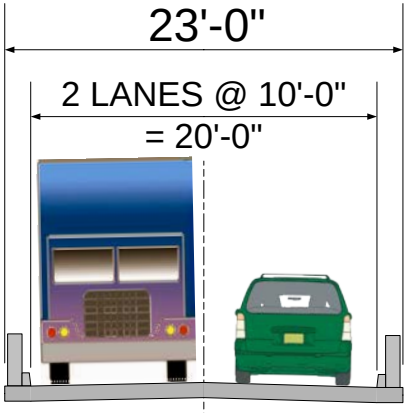
Public Involvement Process
and
KYTC Practical Solutions Initiative

- Consider Lower Cost Bridge Types
- Consider Reduced Bridge Width
- Bridge Type - Be Aesthetically Pleasing
- Stay on Schedule

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

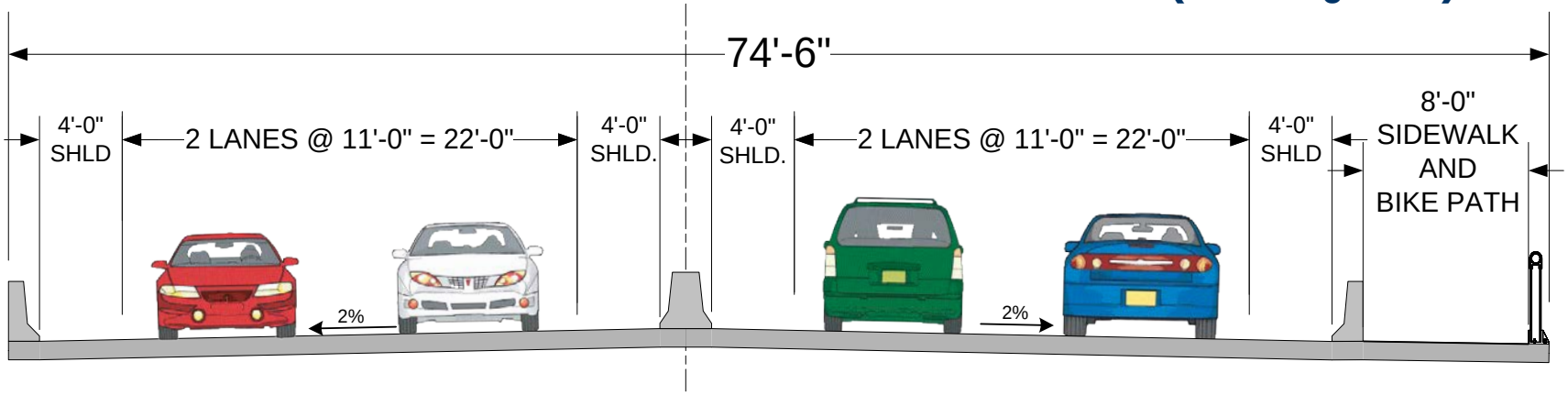
BRIDGE CROSS SECTION

Kentucky Lake (Looking East)



EXISTING TYPICAL SECTION
(Looking East)

Lake Barkley (Looking East)

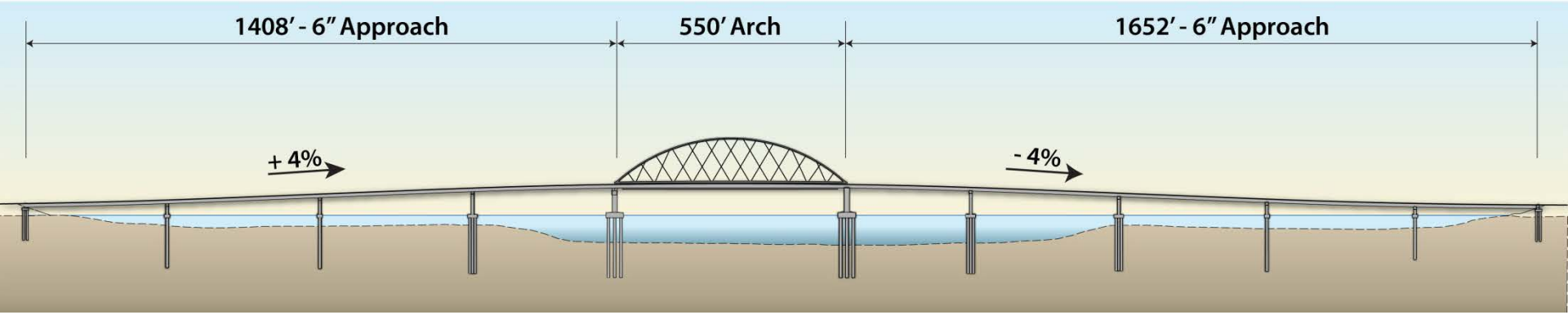


LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

MAXIMIZE CAUSEWAYS

KY Lake

- 9080 Ft Total
- 1400 Ft West Causeway
- 1000 Ft East Causeway
- 580 Ft Lagoon Bridge
- 3611 Ft Lake Bridge
  - 1408.5 Ft West Approach
  - 550 Ft Arch
  - 1652.5 Ft East Approach

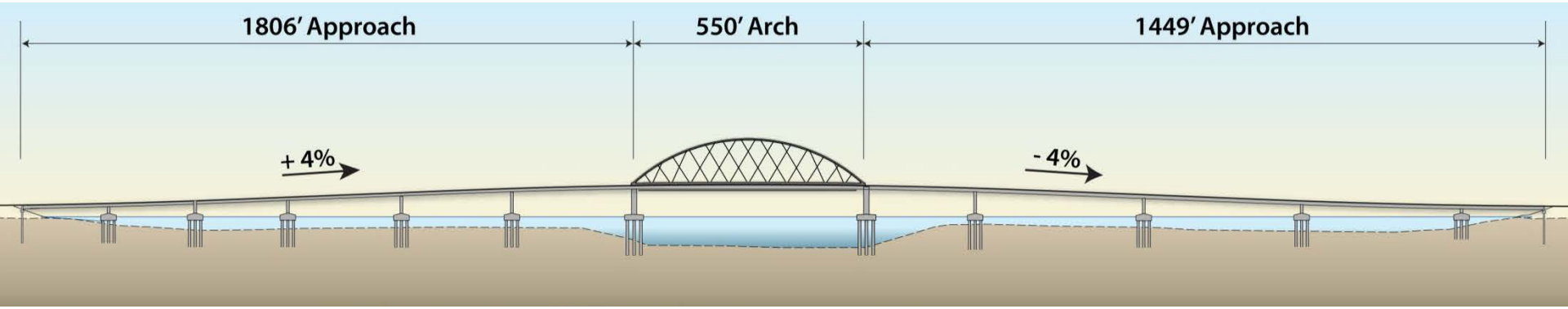


LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

MAXIMIZE CAUSEWAYS

Lake Barkley

- 6050 Ft Total Project
- 650 Ft West Causeway
- 3805 Ft Lake Bridge
  - 1806 Ft West Approach
  - 550 Ft Arch
  - 1449 Ft East Approach



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BASKET-HANDLE ARCH

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

KY LAKE STATUS

Advance Construction

- Lagoon Bridge Construction
- Causeway Fill Material
- Pile Load Tests

Main Crossing Construction

- Basket-Handle Arch
- Approach Spans
- Final Paving & Multi-Use Paths

ADVANCE CONSTRUCTION CONTRACT

Construction Letting

- Letting – February 22, 2013
  - 2 Bids
  - Jim Smith Contracting Co. LLC
  - $24,212,491.14
  - 420 Calendar Days Total
  - Below Engineer's Estimate
- Award Date – March 01, 2013
- Notice to Proceed – April 18, 2013

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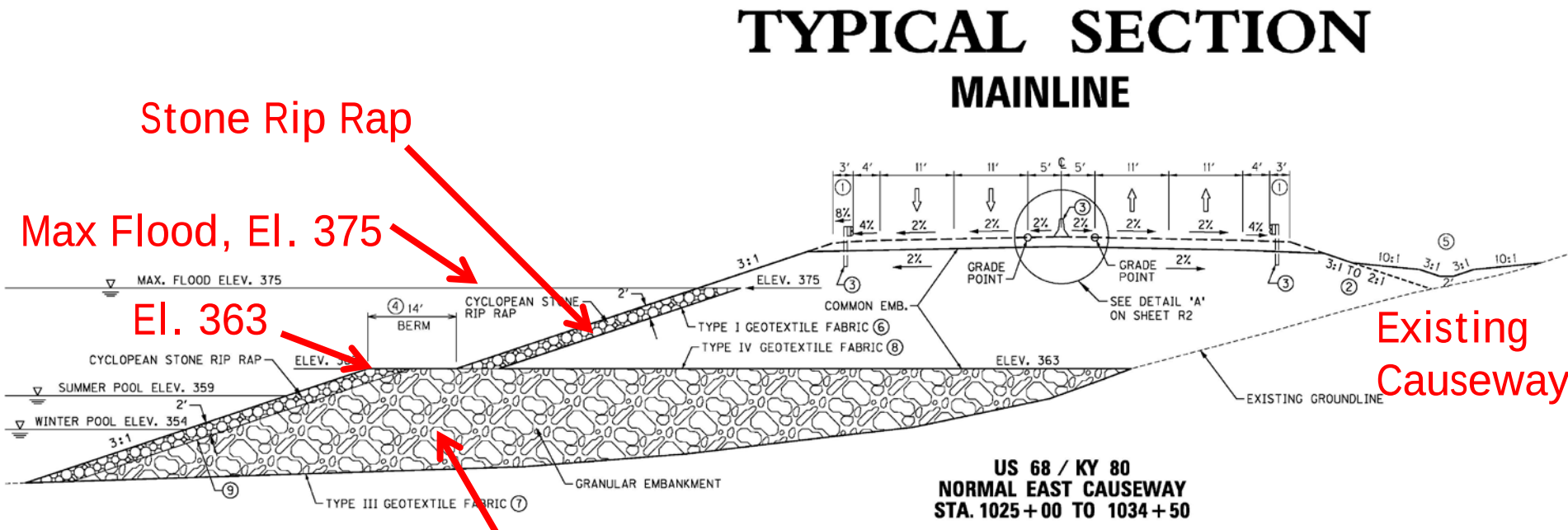
Over Kentucky Lake & Lake Barkley

CAUSEWAY SECTION



Stone Rip Rap

Max Flood, El. 375

El. 363

Existing Causeway

Granular Embankment

3:1 Slopes

Summer Pool, El. 359
Winter Pool, El. 354

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Over Kentucky Lake & Lake Barkley

CAUSEWAY MATERIAL

QUANTITIES

Granular Embankment
165,400 CY

Embankment in Place
172,500 CY

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CAUSEWAY MATERIAL IN PLACE

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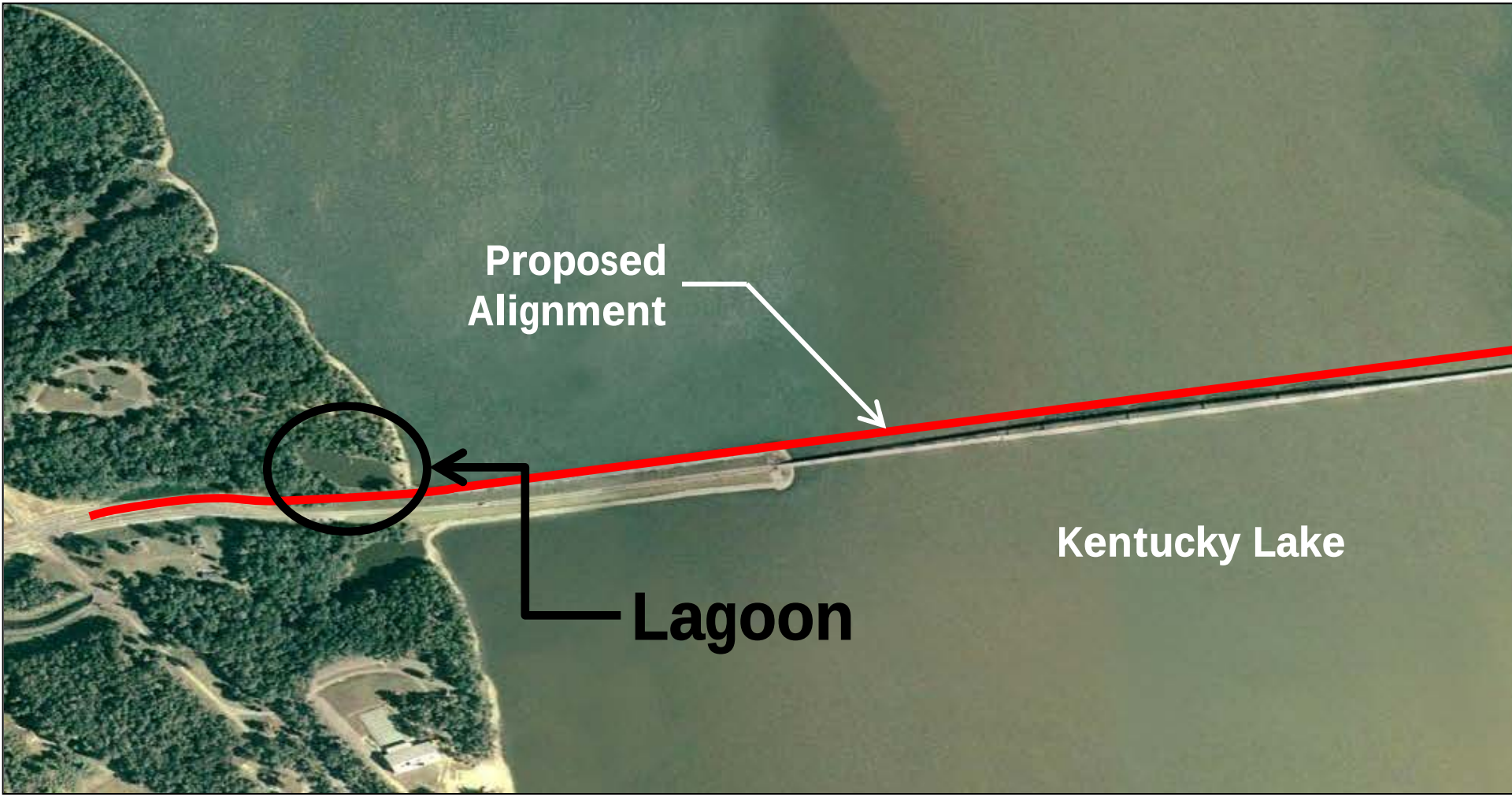
LAGOON BRIDGE



LAKE BRIDGES
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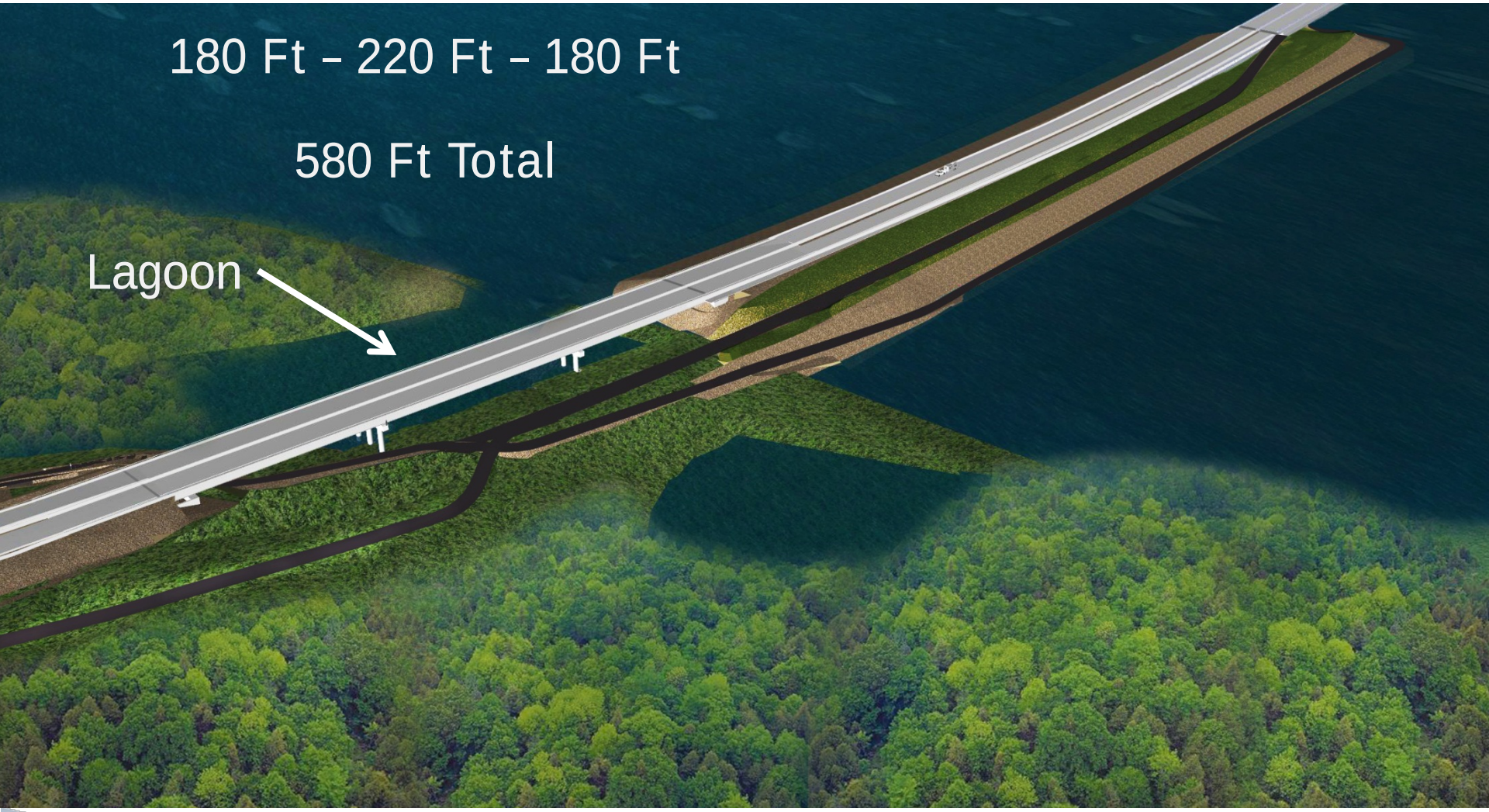
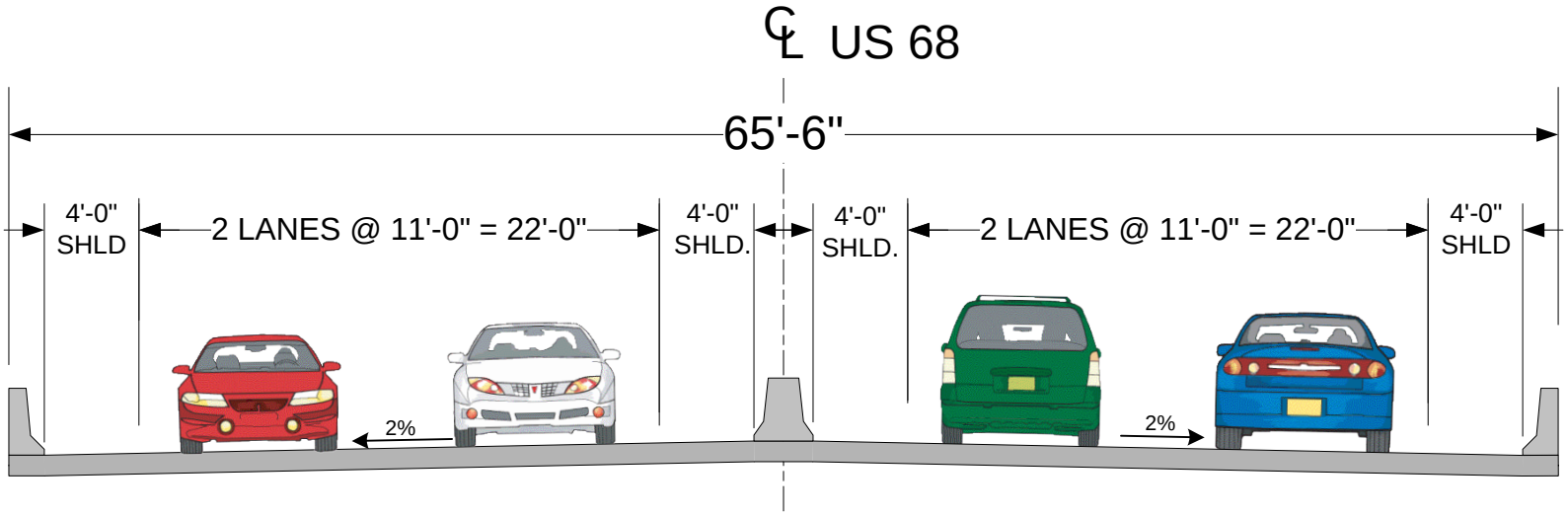
LAGOON BRIDGE



LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

LAGOON BRIDGE



TYPICAL SECTION

(Looking East)

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

THE LAGOON

PILE LOAD TESTING

Purpose

- Confirm Geot. Parameters
- Test Drivability
- Refine Ground Response
- Test Pile Capacity

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Over Kentucky Lake & Lake Barkley

PILE LOAD TESTING

Test Piles

- 48” Piles
- 72” Piles
- 1” Wall
- 1.5” Wall
- 2” Wall

- Near Causeway
- Deep Water

- Open End
- Constrictor Plate

PILE LOAD TESTING

Results

- Relatively Easy to Drive
- Constrictor Plate Functional
- Tip Resistance Near Est. Elev.
- Thinner Walls – No Significant Damage

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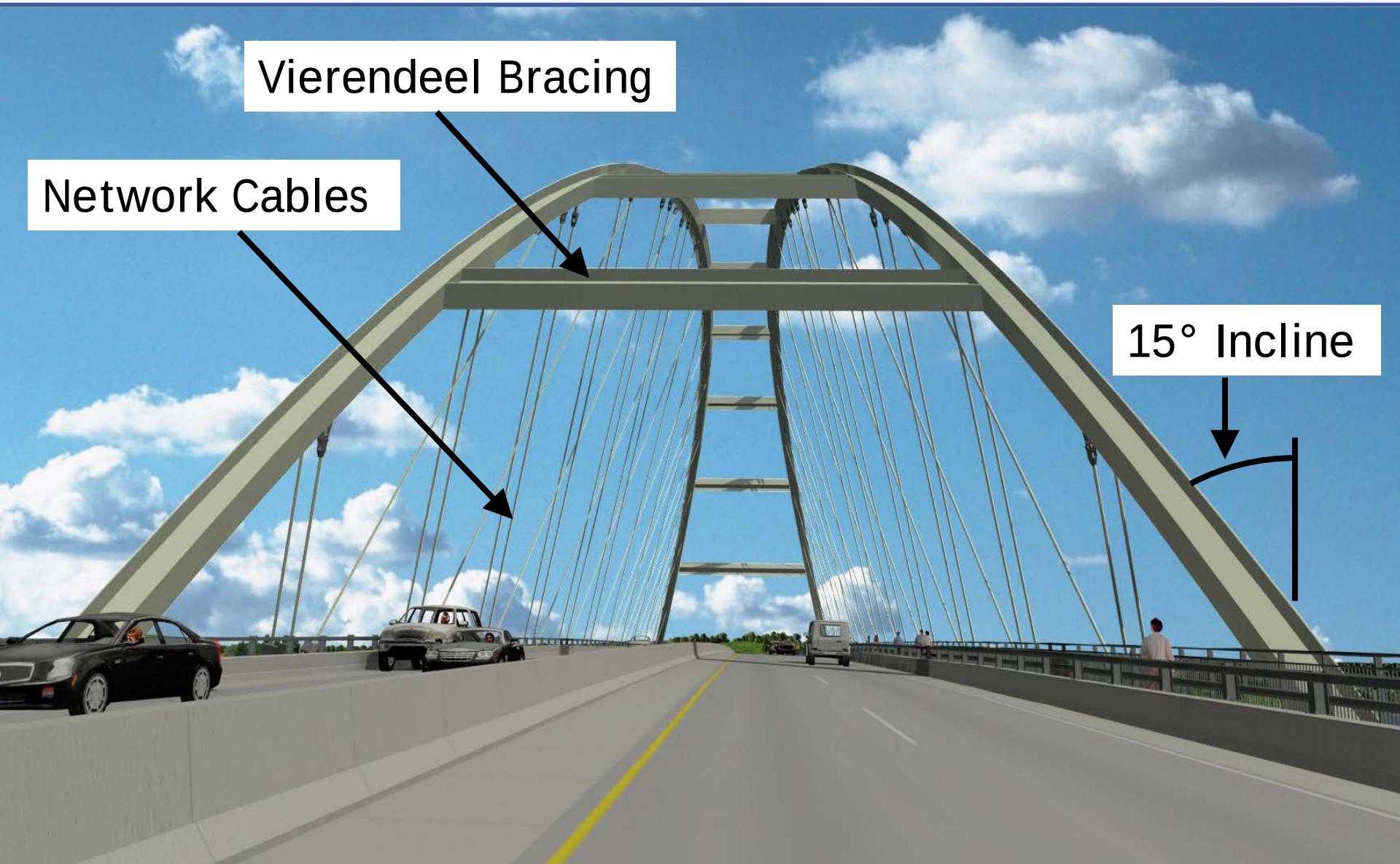
Over Kentucky Lake & Lake Barkley

ARCH BRIDGE

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

KY LAKE DESIGN



LAKE BRIDGES
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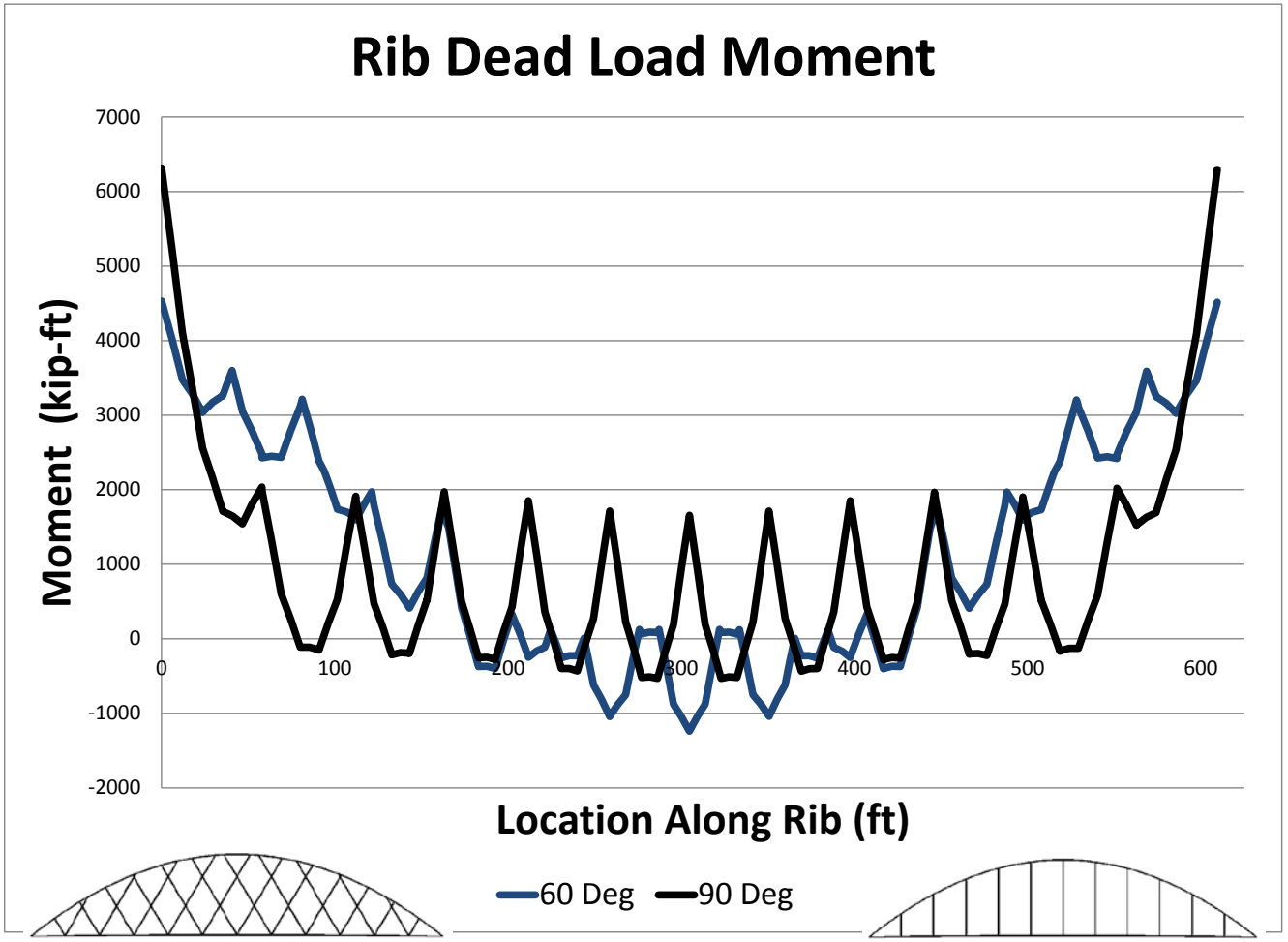
NETWORK STUDY RESULTS

- Minimal Affect on Dead Load Moments



LAKE BRIDGES
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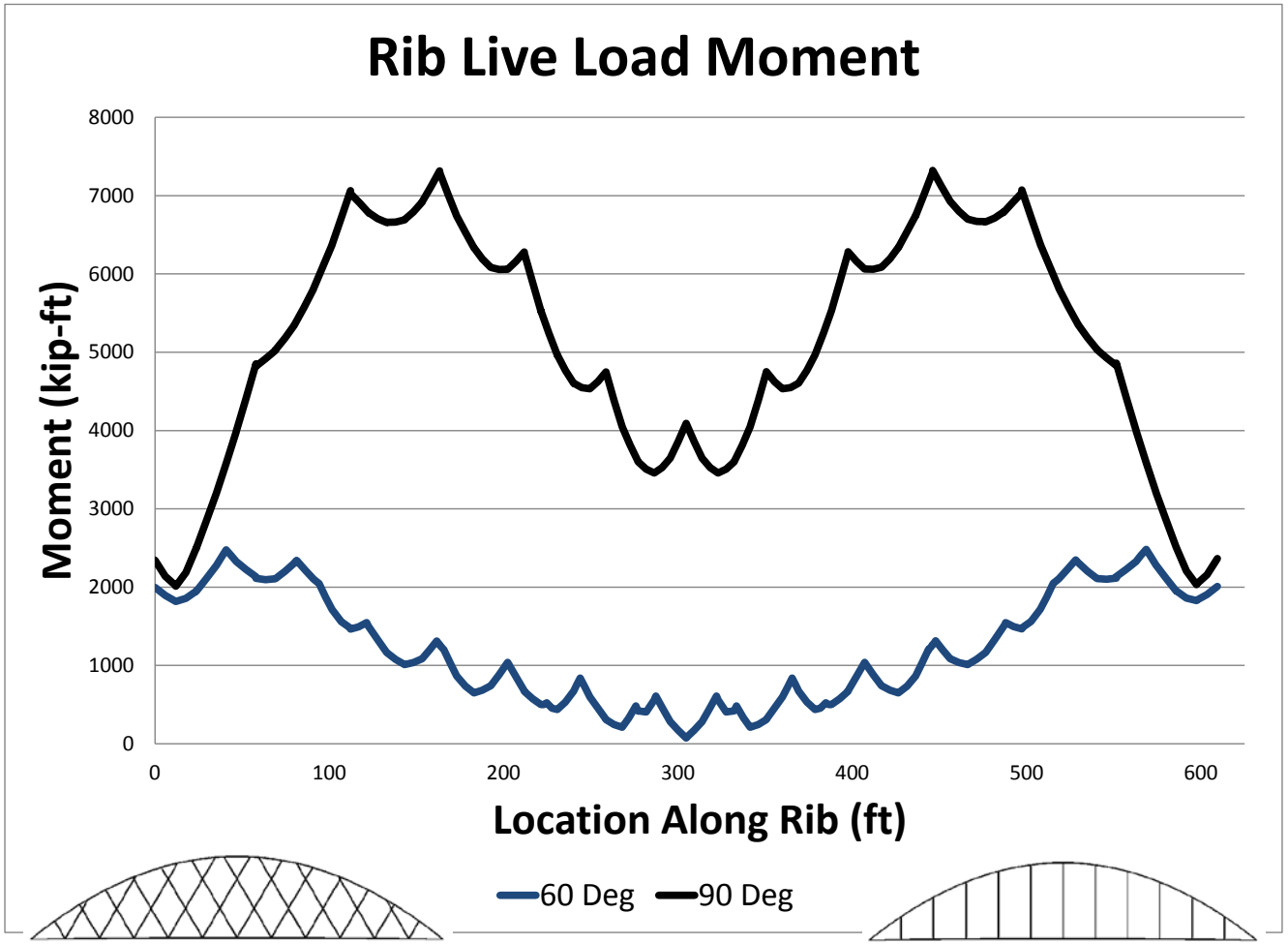
NETWORK STUDY RESULTS

- Major Reduction in Max. Live Load Moments



Criteria and Objectives

- AASHTO LRFD Seismic Design
- “Essential” Bridge Classification
- 1000 Year Return Period
- Elastic During Seismic Event
- Remain Open After Seismic Event
- Minor Repairs After Seismic Event

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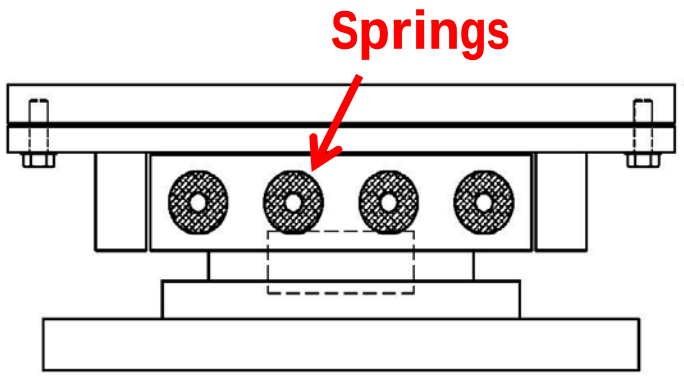
SEIZMIC SOLUTIONS

- Modular Exp. Joints

- Isolation Bearings



Middle Bearings (2)

Joint Movements:
- 18” Longitudinal
- 6” Transverse

- Seizmic Dampers

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HANGER

- KYTC prefers Bridge Structural Strand
- Good track record within KY
- Ribs designed for:
  - Sudden Loss
  - Replacement

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H-SECTION RIB

- Box Versus H-Section
  - Fabrication, Maintenance, Inspection
- H-Section Challenges
  - In-Plane Moment, H-section Weak Axis
  - Hanger Loss
  - Torsion in End Panel
- H-Section Benefits
  - Economical
  - Inspectable
  - Hanger Connection

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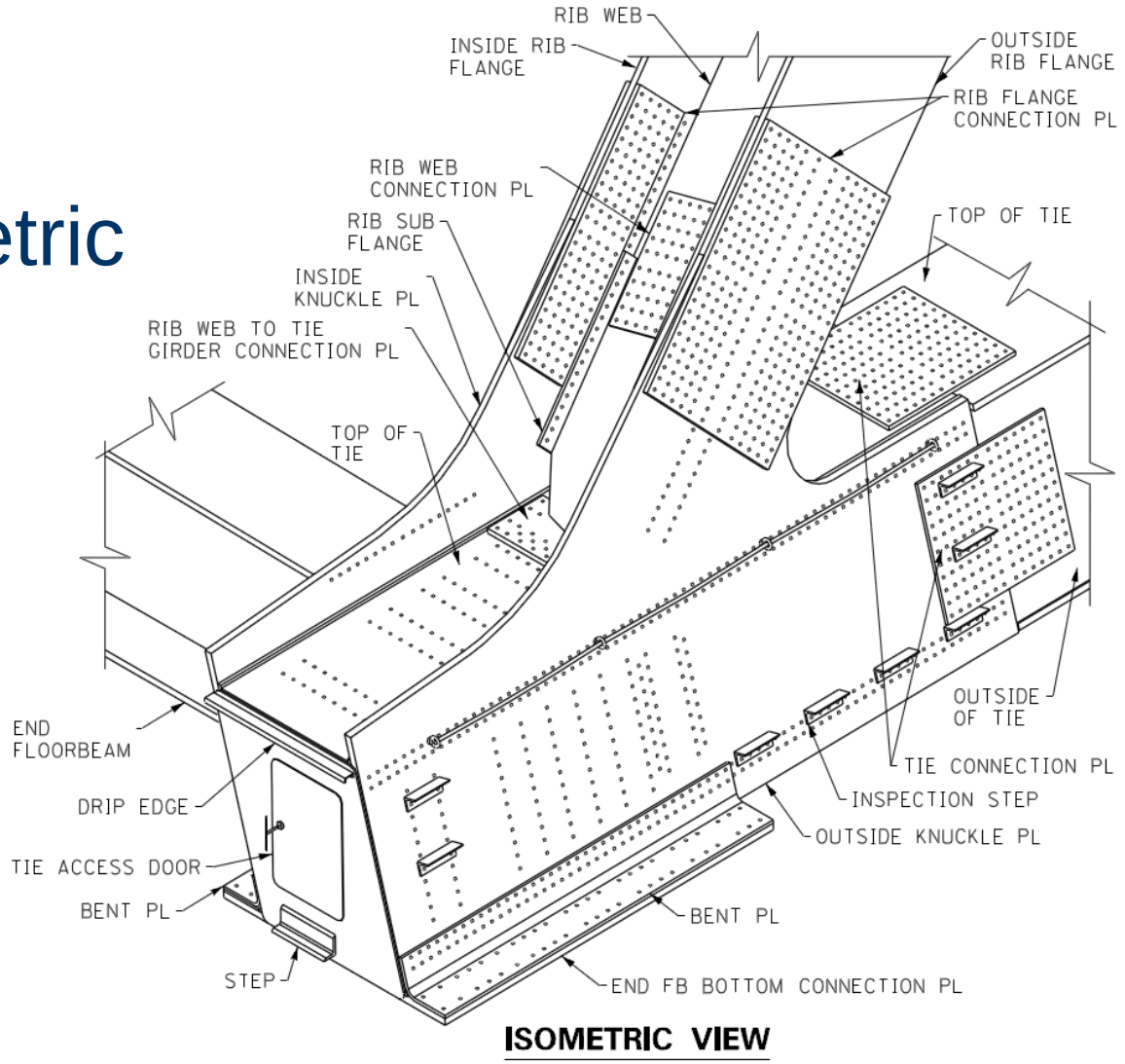
Over Kentucky Lake & Lake Barkley

KNUCKLE

- Rib / Tie / End FB
- Critical for Geometric Control
- Most Complex Fabrication Item
- 3-D FEA



LAKE BRIDGES
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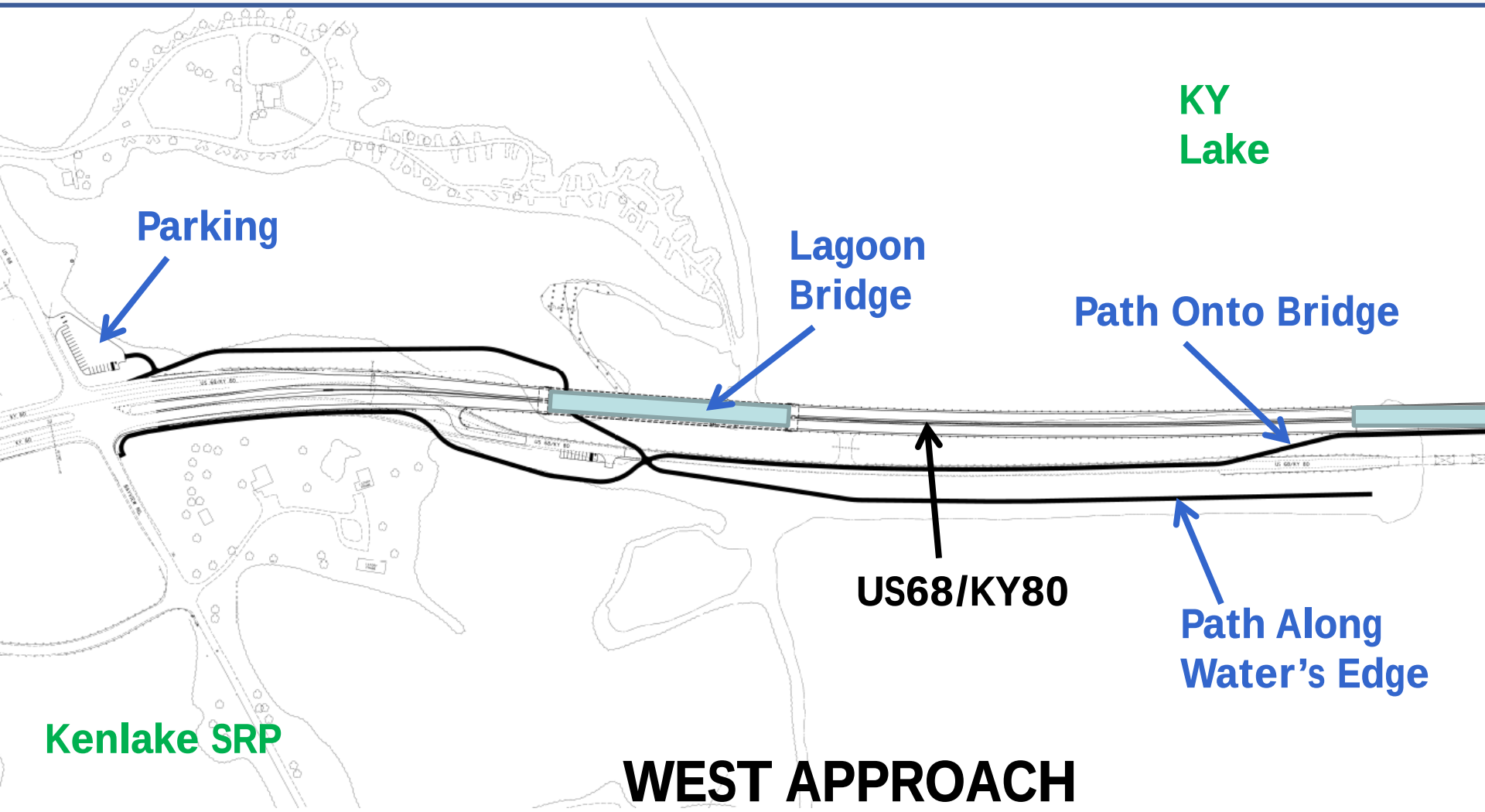
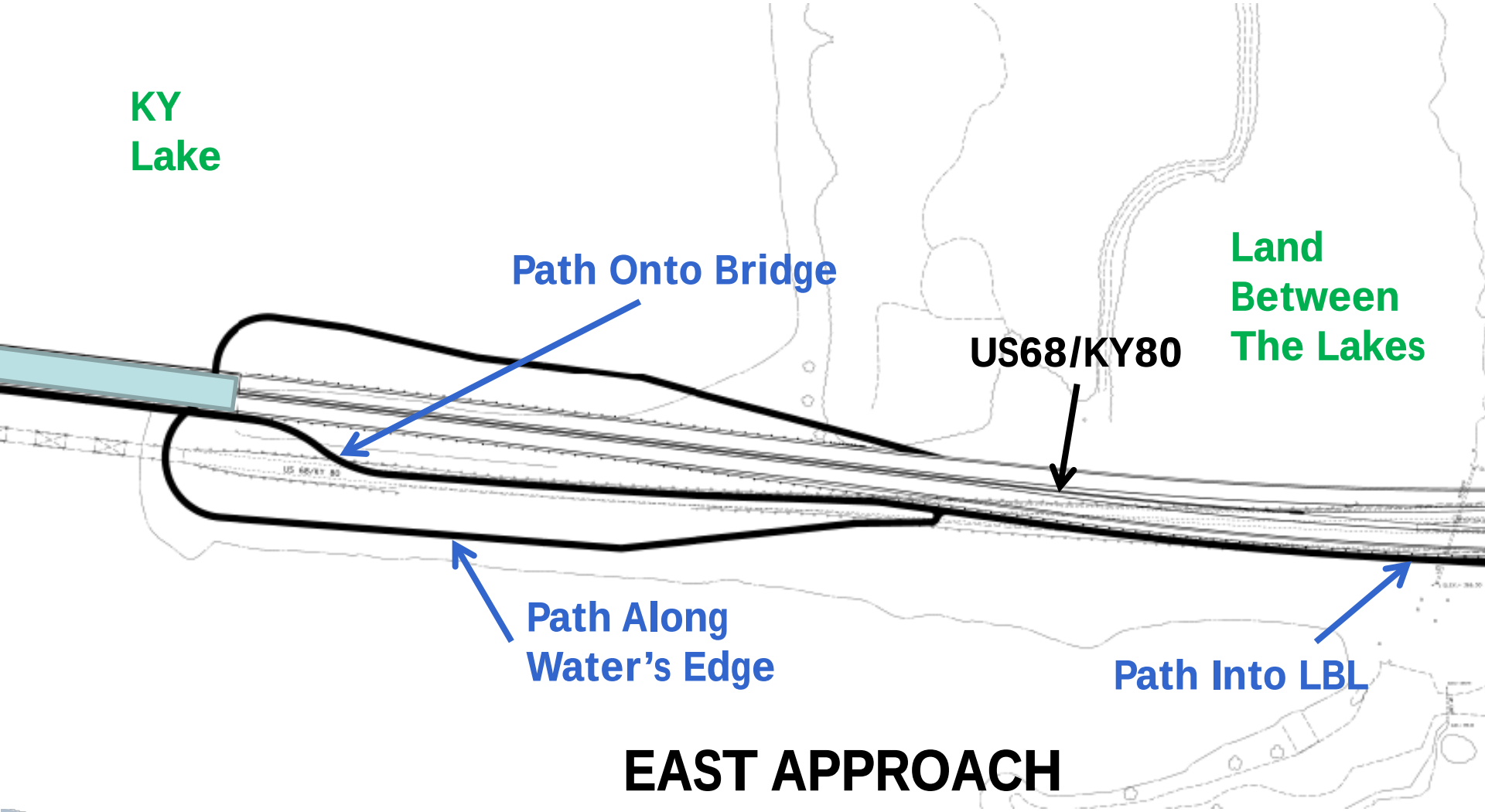
KY LAKE MULTI-USE PATH



WEST APPROACH

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

KY LAKE MULTI-USE PATH



EAST APPROACH

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

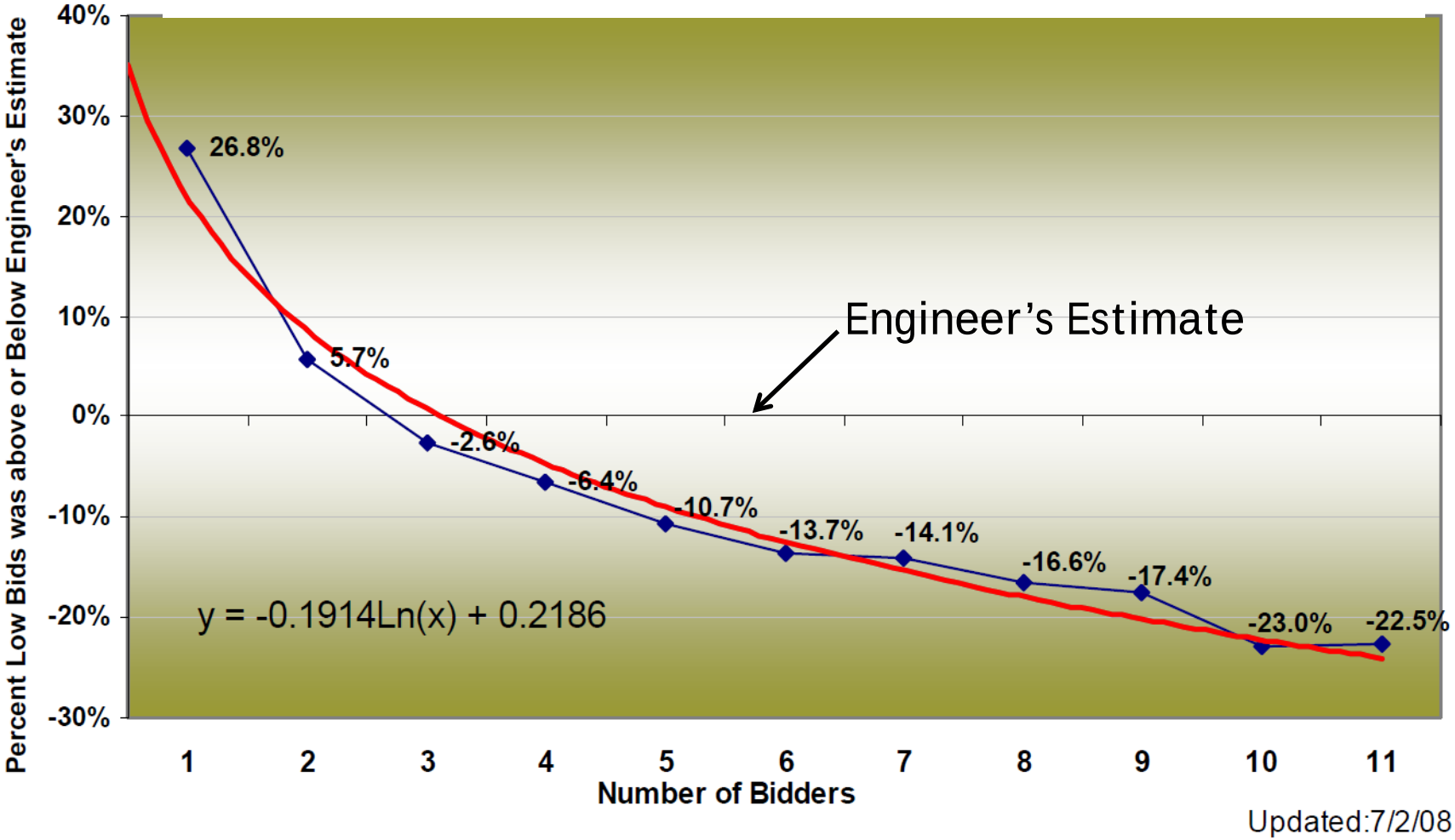
BRIDGE LETTING

- KYTC Committed to Contractor Info
  - 60% Plans, 90% Plans, Preliminary Special Note, etc.
  - Changes Tracked
  - Contractor Information Meeting
- Special Letting Date
- Marketing Info to Industry Groups
- Revisions to Reduce Constr. Costs

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

EFFECT OF MULTIPLE BIDDERS

Low Bid vs. No. of Bidders



Updated:7/2/08

Source: From OE Database FY 1993/1994 through FY 2007/2008, All projects, 9345 projects evaluated

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

BID RESULTS

December 20, 2013 Letting

Bid Appraisal		
BIDDER	BID	% Engineers Estimate
		$151,145,198.59
JOHNSON BROS CORP.	**$131,501,214**	-13.00%
C J MAHAN CONST J/V PARSONS CONST GROUP	$135,737,695	-10.20%
AMERICAN BRIDGE CO J/V TRAYLOR BROS INC	$138,087,832	-8.60%
FLATIRON CONSTR INC J/V MANSON CONST CO	$138,702,237	-8.20%
TULLY CONSTRUCTION CO INC	$143,676,340	-4.90%
ALBERICI-KENNY JOINT VENTURE	$144,182,351	-4.60%
MASSMAN-WALSH A JOINT VENTURE	$146,932,356	-2.80%
KAY & KAY CONTRACTING LLC	$163,974,800	8.50%
AVERAGE	**$142,849,353**	-5.50%

LAKE BRIDGES
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CONCLUSIONS

- First Network Arch in KY
- First Basket-Handle Arch in KY
- Designed for Fabrication, Construction, Maintenance, and Inspection
- Design Goal:
  - "Minimize Risk Not Minimize Material!"
- Maximize Competition

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

KY LAKE @ NIGHT

LAKE BARKLEY STATUS

TS&L/Prel. Engineering Begun

- May - TS&L
- July - 60% Plans
- October – 90% and Final Plans
- Nov Advertisement

December 2014 Letting

Subsurface Exploration

- Main Span Piers Drilled
- Approach Span Piers – Spring 2014

LAKE BARKLEY ARCH

KY Lake Similarities

- Basket-Handle Arch
- 550’ Span
- Typical Section
- Network Cables

KY Lake Differences

- FOUNDATIONS
  - Limestone, Karst Material
  - Drilled Shafts vs. Piles
- ACOE Requirements

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LAKE BARKLEY

LAKE BRIDGES
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LAKE BARKLEY

LAKE BRIDGES
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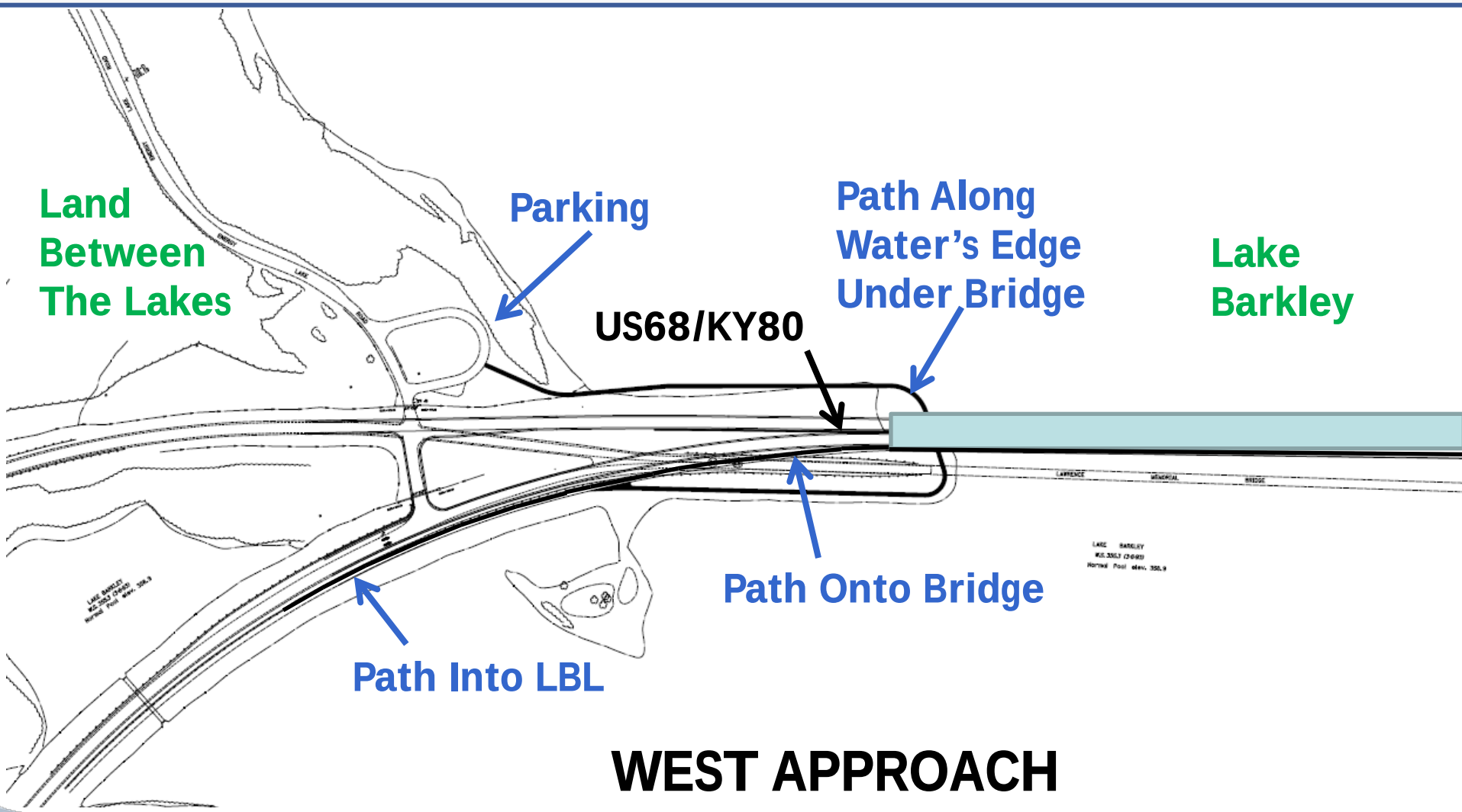
LAKE BARKLEY MULTI-USE PATH



WEST APPROACH

LAKE BRIDGES
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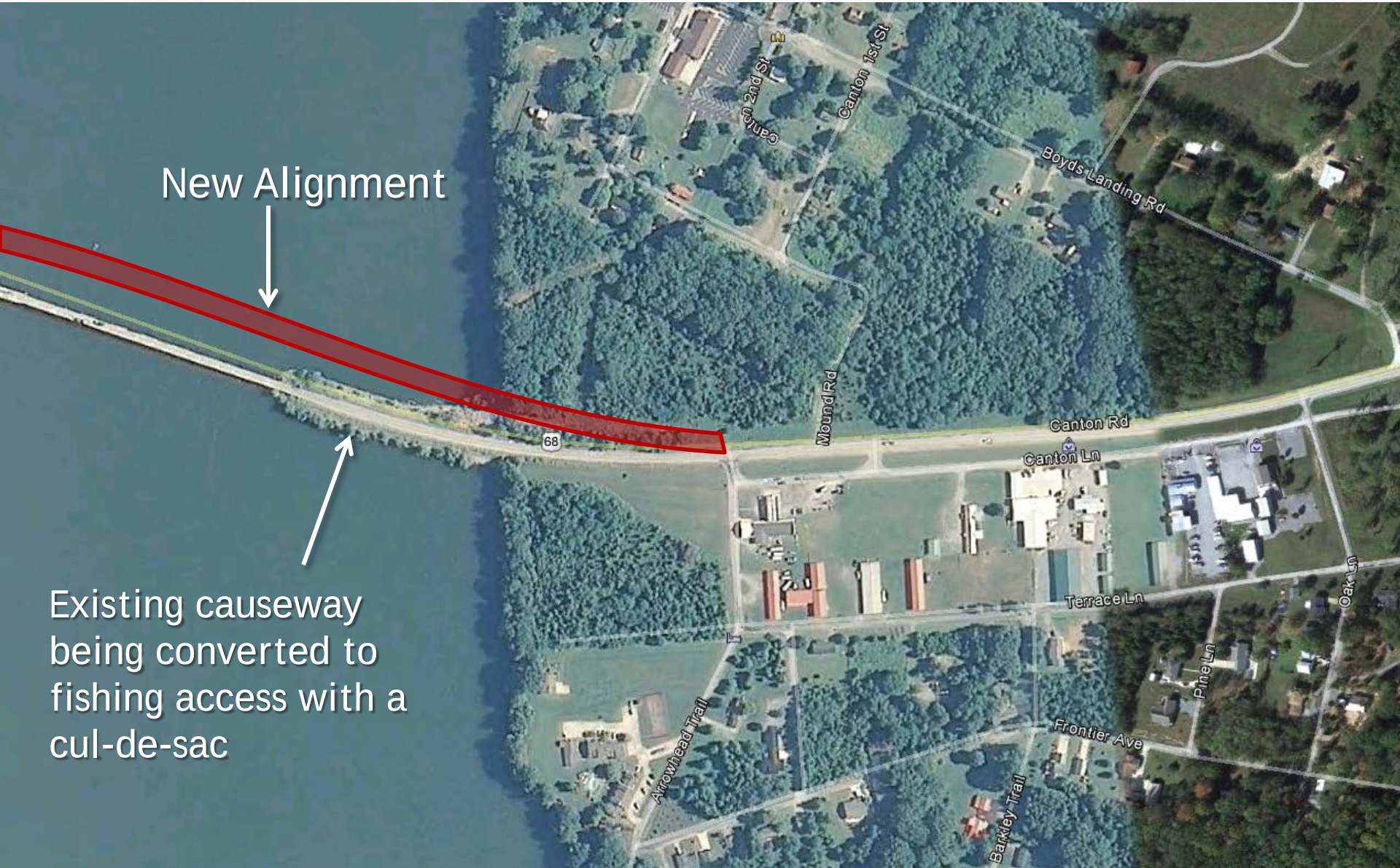
Canton Public Access



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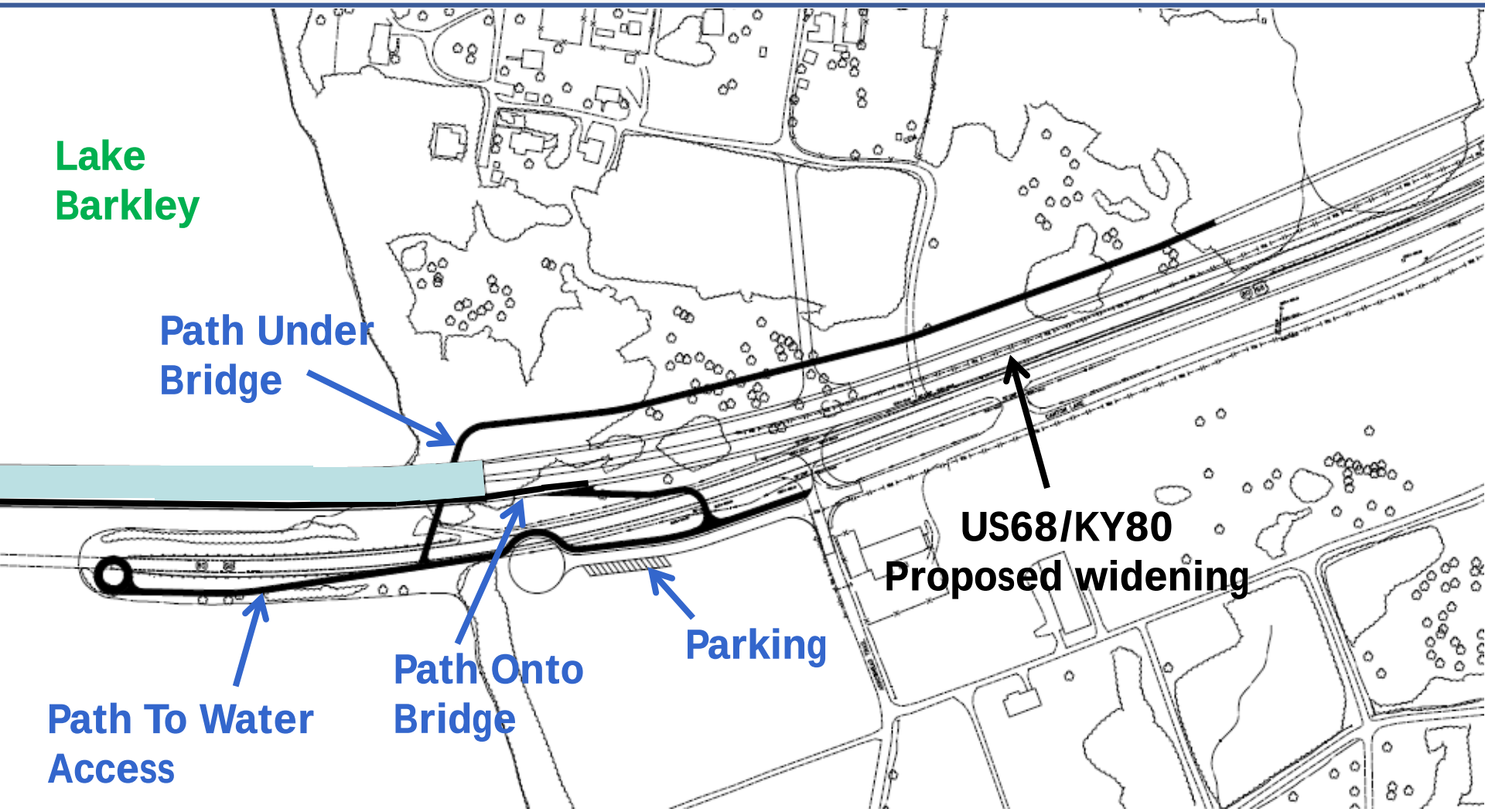
LAKE BARKLEY MULTI-USE PATH



EAST APPROACH

LAKE BRIDGES
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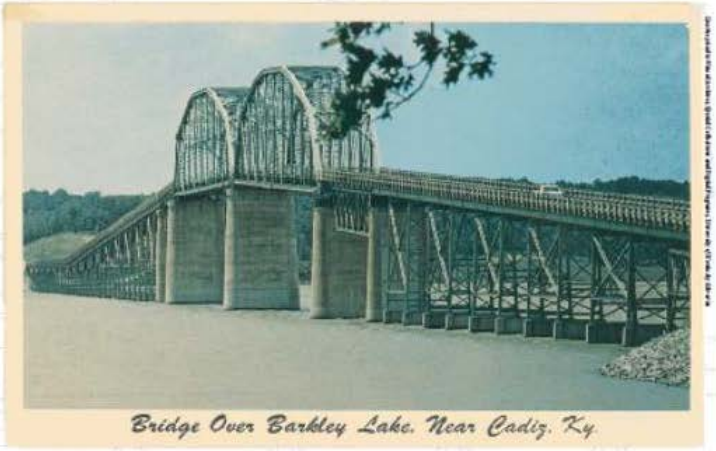
INTERPRETIVE SIGNS

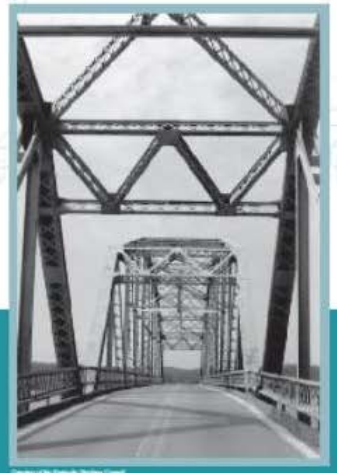
Henry R. Lawrence Memorial Bridge

The Kentucky Department of Highways constructed the Henry R. Lawrence Memorial Bridge in 1934. Its name honors Henry R. Lawrence, then-editor of the Trigg County newspaper and long-time advocate of good roads for western Kentucky.

When built, the Lawrence Memorial Bridge spanned the Cumberland River. By the mid-1950s, plans were underway to dam the river and create Lake Barkley. In 1962, engineers raised the truss of the Lawrence Memorial Bridge ten and one-half feet to provide clearance for the new lake.

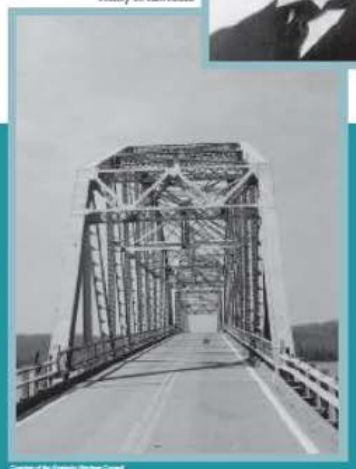


A Henry R. Lawrence Memorial Bridge postcard, ca. 1960



Henry R. Lawrence Memorial Bridge was determined to be eligible for the National Register of Historic Places for its association with the Murphy Toll Bridge Act of 1928.

Henry R. Lawrence



Paving the Way for Kentucky's Modern Highways

The passage of the Murphy Toll Bridge Act of 1928 made construction of the Henry R. Lawrence Memorial Bridge possible. This act gave the state the power to acquire privately owned toll bridges and to issue bonds to construct new bridges. It also allowed the state to collect tolls on the bridges to pay for their construction and maintenance. The Murphy Toll Bridge Act paved the way for Kentucky's modern road system.

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WWW.LAKEBRIDGES.COM

Project Overview

Public Involvement

Current Construction

Webcam Coming Soon